SOME SIGNAL PROCESSING TECHNIQUES FOR USE IN BROADBAND TIME DOMAIN MICROWAVE SPECTROSCOPY

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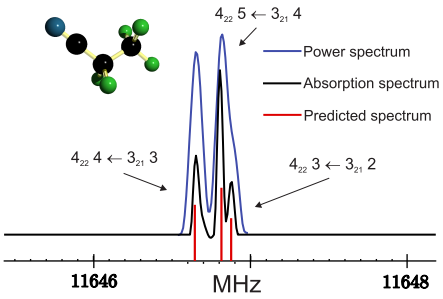

At the present time, in the typical broadband, time domain microwave spectroscopy experiment each free induction decay (FID) collected is on the order of 10^6 data points in length with a sampling rate on the order of 10^{-12} seconds per point. Traditionally, the FID is processed using a fast Fourier transform algorithm (FFT) with the resulting power spectrum used in ensuing spectral analyses. For use with the FFT algorithm we have implemented some pre- and post-processing techniques to improve the signal quality. These techniques include the use of Lissajous plots to ensure phase stability in signal addition, novel windowing functions, and also automated broadband phase corrections which allow the absorption spectrum to be used as a more highly resolved version of the traditional power spectrum (see figure). We have also implemented alternatives to the FFT algorithm for time domain signal processing including Hankel singular valued decomposition, a maximum entropy method, and wavelet transformations. Although these techniques are unlikely to be used in place of a fast Fourier transform we will demonstrate how each of these techniques may be used to augment the traditional FFT algorithm in regards to spectral analysis.